



HAZARDOUS NOISE PROGRAM

The criteria in this standard are the Air Force's minimum occupational health requirements. A program is established in this standard to prevent possible harmful effects to personnel from exposure to hazardous noise. This standard applies to all USAF organizations, including all US Air Force Reserve units and members. It also applies to Air National Guard when published in the NGR (AF) 0-2. Major commands (MAJCOMs), field operating agencies (FOAs), and direct reporting units (DRUs), supplement this standard when additional or more stringent safety and health criteria are required as outlined in AFI 91-302, *Air Force Occupational Safety and Health Standards* (formerly AFR 8-14). Refer to AFI 91-301, *The US Air Force Occupational Safety, Fire Prevention, and Health Program* (formerly AFR 127-12) for instructions on processing supplements or variances. Report conflicts in guidance between this standard, federal standards, or other directives through MAJCOM, DRU, or FOA ground safety offices to HQ USAF/SGPA, 170 Luke Avenue, Suite 400, Bolling AFB DC 20332-5133. The use of the name or mark of any specific manufacturer, commercial product, commodity, or service in this publication does not imply endorsement by the Air Force.

This standard applies to all Air Force military and civilian personnel (including foreign nationals) and to all sources of noise on Air Force facilities or under Air Force control. Contractor personnel are exempt from this standard. This standard implements regulatory portions of applicable Occupational Safety and Health Administration (OSHA) standards (29 CFR 1910.95, *Occupational Noise Exposure*) and also contains material from International Standards Organization (ISO) Standard 1999. OSHA cross-references are included at the end of applicable paragraphs.

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Chapter 1

RESPONSIBILITIES

1.1. HQ USAF:

1.1.1. **Air Staff.** All Air Staff elements will ensure their activities are conducted in a manner consistent with the spirit and intent of this standard.

1.1.2. **The Surgeon General (SG).** The Director of Professional Services (HQ USAF/SGP):

1.1.2.1. Establishes policy for control of hazardous noise.

1.1.2.2. Establishes personnel hazardous noise exposure standards and criteria.

1.1.2.3. Provides professional advice and guidance applicable to noise hazard exposure, noise hazard surveillance, and biomedical research programs.

1.1.2.4. Acts as the approval authority for waivers of protection standards and control procedures.

1.1.3. **Air Force Safety Agency (AFSA).** Establishes standards for safety programs associated with hazardous noise exposure.

1.1.4. **Air Force Inspection Agency (AFIA).** Implements inspection programs to ensure compliance with the requirements in this standard.

1.2. Air Force Materiel Command (AFMC):

1.2.1. Ensures technical orders, handbooks, and similar publications contain those health procedures and precautions needed to prevent the exposure of personnel to noise in excess of this standard.

1.2.2. Makes and changes Tables of Allowances (TA) and military specifications relative to noise hazards and equipment.

1.2.3. Maintains a technology program to define the biological effects of noise of significance to Air Force operations.

1.2.4. Provides information to using commands concerning the adequacy of noise hazard protective devices, materials, and engineering control measures.

1.2.5. Designs each new system to minimize noise exposures throughout the life cycle of the system.

1.2.6. In particular, the HQ Human Systems Center (HSC), Armstrong Laboratory, will through the:

1.2.6.1. Occupational and Environmental Health Directorate, Occupational Medicine Division (AL/OEM, Brooks AFB TX):

1.2.6.1.1. Keeps information on ways to measure, evaluate, and control occupational noise of concern to the Air Force.

1.2.6.1.2. Has specialized noise measuring equipment necessary to monitor and record various types of noise of

biological significance or which might interfere with successful conduct of Air Force operations.

1.2.6.1.3. Conducts industrial and environmental noise surveys and help find the need for and type of noise control measures required.

1.2.6.1.4. Sends HQ USAF/SGPA copies of reports, studies, and other information relating to noise control.

1.2.6.1.5. Works with other AFMC laboratories to evaluate any unique or unusual noise problems.

1.2.6.1.6. Helps solve specific operational noise problems, such as speech interference and communication in noise.

1.2.6.1.7. Maintains an information repository on noise characteristics of noise producing equipment typically found in Air Force industrial workplaces.

1.2.6.2. **Armstrong Laboratory, Biodynamics and Biocommunications Division (AL/CFB, Wright-Patterson AFB OH):**

1.2.6.2.1. Develops technology and gives advice on bioacoustical and physical acoustic problems.

1.2.6.2.2. Develops technology on speech interference and communication in noise.

1.2.6.2.3. Performs special acoustic and biomechanic studies, including ultrasonic and infrasonic criteria development.

1.2.6.2.4. Develops impact or impulse noise criteria.

1.2.6.2.5. Develops technologies for noise related aspects of biomechanics and vibration.

1.2.6.2.6. Develops active noise control technology.

1.2.7. Through the USAF School of Aerospace Medicine (USAFSAM), run formal training programs for medical personnel on managing the Hazardous Noise Program.

1.3. **US Air Force in Europe (USAFE).** Through resources of 7100 Combat Support Wing (CSW) Medical Center/SGB, gives advice and aid similar to that tasked to Armstrong Laboratory (AL/OEM).

1.4. Major Commands:

1.4.1. Ensure operation and maintenance activities implement measures to prevent personnel exposure to hazardous noise in excess of the limits prescribed in this standard.

1.4.2. Request specific hazardous noise exposure criteria or standards not contained herein from HQ Air Force Medical Operations Agency (AFMOA)/SGP.

1.4.3. Contact the Armstrong Laboratory for guidance and assistance in resolving personnel hazardous noise exposures.

1.4.4. Ensures as part of the medical staff assistance program, a review of the base hazardous noise program.

1.5. Host Wing, Center, and(or) Division Commander:

1.5.1. Runs an integrated base hazardous noise protection program, to include noise control by operational means, building design, and land use planning.

1.5.2. Informs the Director of Base Medical Services (DBMS) of each new operation, job, or procedure before the start of normal operations so a noise survey or analysis can be performed.

1.5.3. Makes sure work areas identified by the DBMS as hazardous noise areas are clearly posted.

1.5.4. Makes sure proper corrective action according to AFI 91-301 (formerly AFR 127-12), is taken when a risk assessment code is assigned to a hazardous noise situation.

1.5.5. Enforces the use of hearing protection devices and other noise control methods. Hearing protection should also be furnished to personnel participating in high noise recreational activities on base such as skeet shooting or wood and auto hobby shops.

1.5.6. Runs a continuing program of education and indoctrination on noise exposure risks and methods of controlling undesirable exposures.

1.6. Director of Base Medical Services (DBMS):

1.6.1. Runs the medical portions of the Hazardous Noise Program.

1.6.2. In particular, the DBMS will, through the:

1.6.2.1. Bioenvironmental Engineering Services (BES):

1.6.2.1.1. Perform hazardous noise surveillance to determine if workers who are potentially exposed to hazardous noise require engineering controls, administrative controls, or personal protection, or if potential hazardous noise areas require posting. Inform commanders of the need for marking hazardous noise areas. Provide to the director of safety a listing of hazardous noise areas which identifies the physical boundaries and conditions of use for which hearing protection is required (example at attachment 3).

1.6.2.1.2. Review facility and operations plans for new or modified facilities to ensure noise exposure control is appropriately considered.

1.6.2.1.3. Perform a noise survey or assessment of each new job before new operations start.

1.6.2.1.4. Assign a Risk Assessment Code (RAC), per AFI 91-301 (formerly AFR 127-12), when hazardous noise areas or exposures are identified and permanent engineering controls or administrative procedures are feasible.

1.6.2.1.5. Evaluate the effectiveness of engineering controls, administrative procedures, and hearing protection devices in reducing worker noise exposure.

1.6.2.1.6. Notify the supervisor of worker identified as being exposed to hazardous noise exposure, in writing within 30 days after all measurements are completed and a final determination is made.

1.6.2.1.7. Include noise survey findings and hearing protection requirements on the AF Form 2755, **Master Workplace Exposure Data Summary** (attachment 4). Forward copy B of AF Form 2755 to Military Public Health (MPH).

1.6.2.1.8. Advise commanders on measuring and controlling worker exposures to noise.

1.6.2.1.9. Determine the type of personal hearing protection devices required, such as ear plugs and muffs, and whether the devices reduce noise exposures to below the limits of this standard.

1.6.2.1.10. Recommend to the Aerospace Medicine Council workplaces where workers should receive periodic audiometric monitoring. Use the following factors in assessing the need for audiometric monitoring.

1.6.2.1.10.1. Audiometric monitoring shall be performed when survey results show a representative daily exposure above 85 dB(A) (as determined from survey procedures in paragraph 3.2.2.2.)), continuous or intermittent exposure above 115 dB(A), or impulse noise exposure above 140 dB peak sound pressure level (29 CFR 1910.95(c)). The daily noise exposure level needs to be measured for a sufficient number of days and individuals to allow for the determination of the average annual noise exposure for inclusion on the AF Form 2755.

1.6.2.1.10.2. Medical and engineering judgment are required for situations where noise dosimetry has not been accomplished, or where dosimetry does not show exposures exceeding the standards. In workplaces where loud sources produce noise levels which could cause significant hearing loss in just a few exposures, personnel may be placed on routine audiometric monitoring in spite of measured exposures not exceeding the regulatory criteria. The jet engine test cell is one example where these types of exposures might occur. Workers who have been on the audiometric monitoring program in the past and whose audiograms show significant threshold shifts may also be considered for continued audiometric monitoring.

1.6.2.1.11. Perform initial siting survey for placement of audiometric booth(s). Perform annual background noise level checks inside audiometric booths to assure compliance with AFR 161-15.

1.6.2.2. Military Public Health (MPH):

1.6.2.2.1. Assists BES in determining the effectiveness of controls through the review of audiometric monitoring data.

1.6.2.2.2. Forwards sufficient copies of AF Form 2755 to

the Physical Exams Section (PES) for inclusion in the medical records of all personnel receiving occupational physicals. If an occupational physical consists solely of audiometric monitoring, the AF Form 2755 is not required in the medical records. MPH will provide PES with the Leq for workers requiring audiometric monitoring.

1.7. Director of Safety (SE):

1.7.1. During scheduled safety inspections, evaluate the hazardous noise program with supervisors to ensure that worker protective measures, to include personal hearing protectors, are being used properly. Ensure that workplace hazardous noise areas, identified by the BES, are properly marked or identified. Discrepancies will be forwarded to the BES for resolution.

1.7.2. Enter any AF Form 3, **Air Force Hazard Abatement Plan**, received from the BES, into the base master hazard abatement plan. Inform the BES of any status changes received from the functional manager responsible for the AF Form 3. (AFI 91-301 [formerly AFR 127-12])

1.8. Supervisor:

1.8.1. Notifies each worker individually who is exposed to hazardous noise after a determination has been made by

BES. Provides information to BES about work practices and procedures involving potential exposure to hazardous noise to allow proper surveys and evaluations of the workplace.

1.8.2. Ensures measures to control exposure to hazardous noise, including engineering controls, administrative controls, and personnel protective measures, are properly used by all workers supervised.

1.8.3. Provides the results of noise surveys and evaluations performed by BES to all workers and documents action in safety training records.

1.8.4. Takes appropriate action to abate all noise hazards as recommended by BES.

1.8.5. Provides workers exposed to hazardous noise training in workplace procedures for protection from hazardous noise.

1.9. Individual:

1.9.1. Always uses the procedures established by the commander to control exposure to noise, including the proper use of hearing protectors.

1.9.2. Provides supervisor and BES information and cooperation in identifying and abating noise hazards.

1.9.3. Participates in noise exposure surveys by wearing survey equipment as requested by BES.

Chapter 2

REQUIREMENTS

NOTE: The requirements in this standard are established to prevent occupational hearing damage and whole body effects from noise, as well as maintaining effective job performance. Performance requirements are only intended to provide effective environments for better job performance. Hearing protection is required when engineering or administrative controls are not practical or effective in protecting against hearing damage, or until engineering controls are installed. A monitoring audiometry program is required, as outlined in AFOSH Standard 161-20, when personnel are exposed to noise equal to or exceeding the noise exposure limits for hearing of this standard, regardless of the protection or administrative controls employed. (29 CFR 1910.95), Health Protection criteria are summarized in table 2.1. Specific details are outlined in separate paragraphs.

Table 2.1. Health Protection Criteria

Hearing Protection	85 dB(A) for 8-hours or equivalent exposure times (See Table 2.2)
Criterion level	85 dB(A)
Exchange rate	3 dB
Threshold level	80 dB(A)
Maximum level	115 dB(A)
Impulse Noise	No unprotected exposure above 140 dB (See also Attachment 2)
Whole Body Effects	No octave or one-third octave band level above 145 dB from frequencies from 1 Hz to 40 kHz
Ultrasound	See Table 2.3
Music Exposure	
Patrons	Leq,2h < 94 dB(A)
Employees	Same as occupational standard
Air Force Musicians	Same as occupational standard

2.1. Noise Exposure Limits--Hearing:

2.1.1. **Limits.** The permissible exposure limits for noise are intended to prevent damage to the hearing organs of exposed personnel. These noise exposure limits are sound levels and durations to which it is believed nearly all

workers may be exposed without permanent adverse effect on their ability to hear and understand normal speech.

2.1.2. **Continuous or Intermittent Exposures.** The duration of unprotected exposure to noise per day shall not exceed the values specified at Table 2.2 for the levels indicated for continuous exposure.

Table 2.2. Limiting Values for Unprotected Noise Exposures. *

Sound Level dB(A)	Time (minutes)	Sound Level dB(A)	Time (minutes)	Sound level (dB(A))	Time (minutes)
Over 115	Forbidden				
115	0.5	102	9.5	89	190
114	0.6	101	12	88	240
113	0.7	100	15	87	302
112	0.9	99	19	86	381
111	1.2	98	24	85	480
110	1.5	97	30	84	605
109	1.9	96	38	83**	762
108	2.4	95	48	82**	960
107	3.0	94	60	81**	1210
106	3.8	93	76	80**	24 Hours
105	4.7	92	95	Below 80	No limit
104	6.0	91	120		
103	7.5	90	151		

* The A-weighted sound level is used to assess hearing damage risk due to exposure to noise; for engineering noise control, other measures are required. The limiting duration of exposure at any noise level equal to or less than 115 dB(A) can also be determined from the equation:

$$\text{Time, } T (\text{minutes}) = 480 \times 2^{(85 - L_A)/3}$$

where, L_A = A-weighted sound level

** Exposures of more than 12 hours should be followed by periods of equal length in quiet (less than 72dB(A))

If exposures to two or more levels occur in one day, their combined effect should not exceed an 8-hour equivalent continuous level, $L_{eq,8h}$, of 85 dB, given by the equation:

$$L_{eq,T} = 10 \log \left(\frac{1}{t_2 - t_1} \int_{t_1}^{t_2} \left[\frac{p_A(t)}{p_0} \right]^2 dt \right)$$

where $t_2 - t_1$ is the time period, T, over which the average is taken starting at t_1 and ending at t_2 . This is equivalent to summing the fractions of the actual time of exposure to the allowable time of exposure. If this value exceeds one, the combined exposure should then be considered to exceed the standard. This may also be expressed mathematically as:

$$\frac{C_1}{T_1} + \frac{C_2}{T_2} + \frac{C_3}{T_3} + \dots + \frac{C_n}{T_n} > 1.0$$

The C values are the times of exposure to a given level; the T values are the times allowed at those levels by Table 2.2. All occupational noise exposures above the threshold level of 80 dB(A) shall be used in the above equations. (OSHA 29 CFR 1910.95)

2.1.3. Impulse or Impact Exposures. Unprotected personnel shall not be exposed to impulse or impact noise exceeding 140 dB peak sound pressure level. Attachment 1 contains detailed information applicable to this limit, as well as levels produced by certain weapons. (OSHA 29 CFR 1910.95)

2.1.4. Hazardous Noise Areas. A hazardous noise area shall be clearly identified by signs located at entrances to, or the borders of, the area. Signs should be designed according to the guidelines in AFOSH Standard 127-45, Attachment 1, and will have the following message:

CAUTION

HAZARDOUS NOISE AREA

HEARING PROTECTION REQUIRED

AF Visual Aid (AFVA) 161-2 may be used for this purpose. Such wordings as "When machines are operating" or "Within 25 feet of operating band saw" may be added at the bottom of the caution sign to accurately identify the noise hazard area. Whenever such modifications are required, the BES will specify the exact wording to be used. Hearing protection shall be worn in a hazardous noise area by all personnel when hazardous noise sources are operating, regardless of exposure duration.

2.2. Noise Exposure Limits--Whole Body Effects.

2.2.1. At certain high levels of sound, exposed persons may suffer adverse effects which do not involve the hearing organs. This limit is to prevent these effects.

2.2.2. No octave or one-third octave band level may exceed 145 dB for frequencies in the range of 1 Hz through 40 kHz, and the overall A-weighted sound pressure level must be below 150 dB(A). There are no time limits for exposures below these levels. However, protection of hearing requires adherence to the limits given in paragraph 2.1.

2.2.3. Special limits apply to upper sonic and ultrasonic acoustic radiation. The values listed at Table 2.3 shall be used as a guide in the control of noise exposure. These

levels apply only to spectra with significant high frequency or ultrasound tones (tones at least 6 dB above the broad band noise at adjacent one-third octave bands) as typically encountered with ultrasound cleaners or other such devices. The levels for one-third octave bands below 20 kHz are below those which cause subjective effects. Those levels above 20 kHz are for the prevention of possible hearing losses from subharmonics of these frequencies. (American Conference of Governmental Industrial Hygienists (ACGIH) Documentation of the Threshold Limit Values (TLVs) and Biological Exposure Indices (BEIs)) Consultation with Armstrong Laboratory may be required in measuring or evaluating equipment producing these levels.

Table 2.3. Maximum Permissible Ultrasound Exposure Levels.

One-Third Octave Band Center Frequency (kHz)	One-Third Octave Band Level (dB re 20 μ Pa)
10	80
12.5	80
16	80
20	105
25	110
31.5	115
40	115
50	115

2.3. Music Exposure Criteria. Average sound levels of loud music may exceed the criteria for possible hearing damage. Exposures to recreational music activities involve two exposure groups: the facility (or activity) customers, considered to be recreationally exposed, and the employees, considered to be occupationally exposed.

2.3.1. Employees. For the occupationally exposed group of employees, the noise exposure limits and other provisions in this standard apply as for any other group of occupationally exposed employees.

2.3.2. Customers. For those recreationally exposed, both entertainment planners and the customers need some understanding of the hazards to make their own decisions. Air Force occupational noise exposure standards are for long-term exposure and cannot be directly applied to recreational exposures. Assuming customer exposure to high levels of loud music is generally limited to 2-hours, once per week, the music level will not exceed an equivalent continuous level, L_{eq} , of 94 dB(A) for any continuous 2-hour period at any customer location.

2.3.2.1. The manager of each facility or activity will monitor, post, or issue precautionary warnings and enforce these limits. Medical service personnel may provide technical assistance in initial monitoring, recommending equipment, and interpreting results.

2.3.2.2. The 94 dB(A) guideline is not a peak or maximum sound level never to be exceeded, but is an average level for monitoring purposes. If levels never exceeded a fixed limit, crescendos and some special effects would be prohibited. The intent is to allow music to be entertaining, but kept within certain safe limits.

2.4. Noise Exposure Limits--Job Performance. The noise exposure limits in this section are provided to maintain effective job performance. These limits should

be used as design values in the construction of new facilities, or to correct problems arising from present conditions which interfere with the accomplishment of current tasks or operations.

2.4.1. Effective Person-to-Person Voice Communication (Conversation). The effects of different sound levels on voice are shown at Figure 2.1. Sound levels are shown in A-weighted levels (dB(A)) and in Speech Interference Levels (SIL) in dB.

2.4.2. Quality of Person-to-Person Communication. The data shown at Table 2.4 provide ranges of sound levels and the corresponding routine communication capability for several situations. When evaluating speech interference near small arms areas, or other areas where hearing protection is worn, the attenuation of the hearing protection will be taken into account.

2.4.3. Office and Work Space. Noise measurements made for comparing noise in an office with these criteria should be done with the office in normal operation, but with no one talking at the particular location where speech communication is being evaluated. Background noise with the office unoccupied should be lower by about 5 to 10 dB(A). Acceptable levels are at Tables 2.5 and 2.6.

2.4.4. Group Meeting, Study, and Rest and Relaxation Areas. Noise measurements made to compare the noise environment in a particular area with these criteria should include both internal and external background noise. Acceptable levels are at Table 2.7.

NOTE: Expected voice represents the increase of voice level a speaker in a noisy field usually adopts. The communicating voice level is the voice level a speaker can produce over the range of sound levels shown when forced to communicate (achieve a 95 percent word score, with positive, instantaneous feedback).

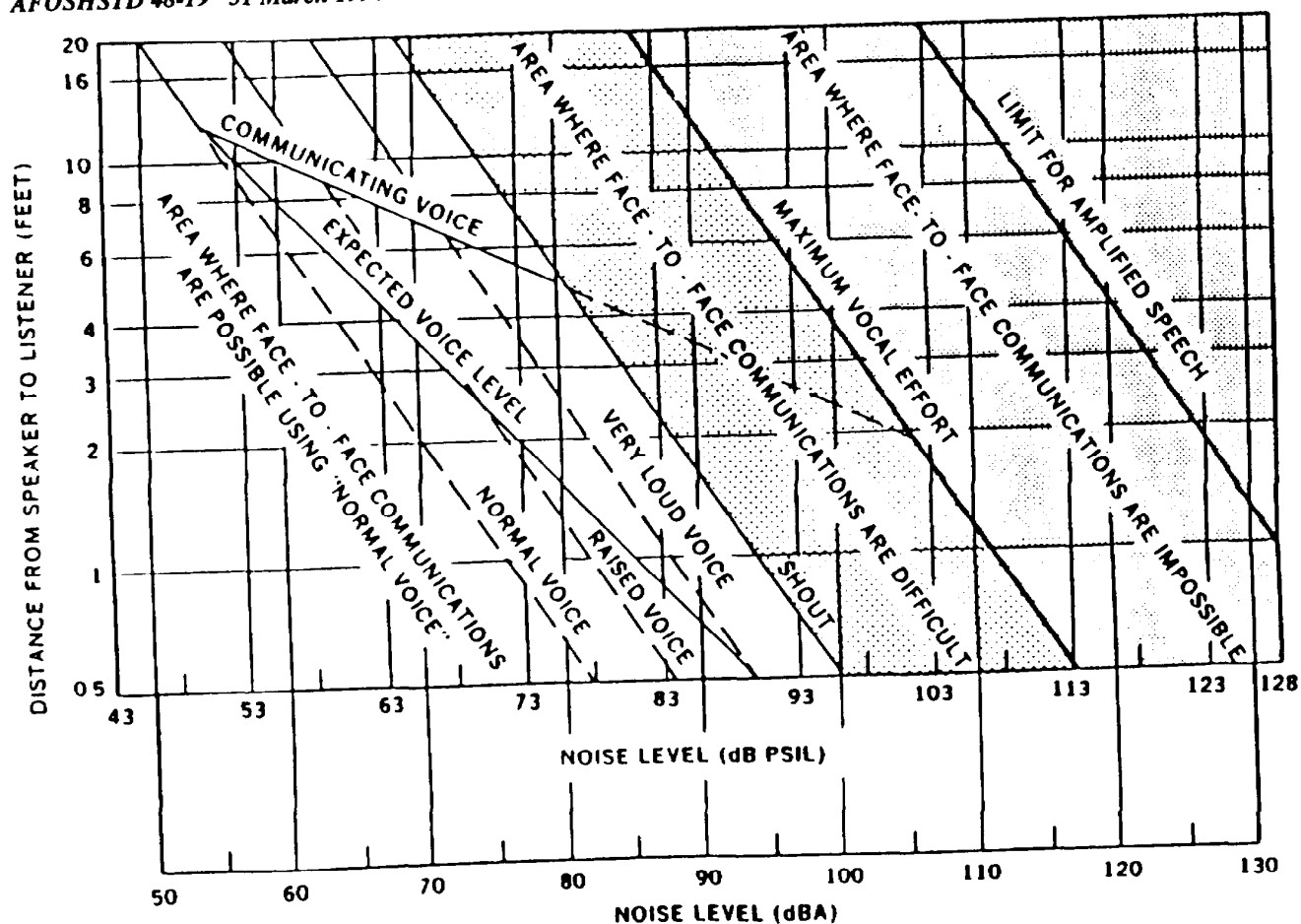


Figure 2.1. Effectiveness of Voice Communication.

Table 2.4. Quality of Person-to-Person Voice Communication.

Noise Level (dB(A))	Voice Levels			Telephone Use
	Normal Voice	Raised Voice	Shouting	
40 to 50	Satisfactory to 30 feet			Satisfactory
50 to 60	Satisfactory to 6 feet	Satisfactory		Satisfactory
60 to 70	Satisfactory to 3 feet	Satisfactory to 6 feet		Satisfactory to slightly difficult
70 to 80*	Satisfactory to 1 foot	Satisfactory to 3 feet		Slightly difficult
80* to 90		Satisfactory to 1 foot,	Slightly difficult	Difficult

Table 2.4. Continued.

Noise Level (dB(A))	Voice Levels			
	Normal Voice	Raised Voice	Shouting	Telephone Use
		Slightly difficult to 6 feet		
90 to 95		Slightly difficult to 2 feet	Slightly difficult to 3 feet	Very difficult
Above 95			Slightly difficult o 1 foot	Unsatisfactory

* Noise exposure limits may be exceeded by a combination of noise plus voice.

Table 2.5. Noise Levels for Offices.

Range of Levels (dB(A))	Communication Environment
30 to 40	Very quiet office, telephone use satisfactory, suitable for large conferences.
40 to 45	Quiet office, satisfactory for conferences at a 15 foot table; telephone use satisfactory; normal voice 10 to 30 feet.
45 to 50	Satisfactory for conferences at a 6 to 8 foot table; telephone use satisfactory; normal voice 6 to 12 feet
50 to 60	Satisfactory for conferences at 4 to 5 foot table; telephone use occasionally slightly difficult; normal voice 3 to 6 feet; raised voice 6 to 12 feet.
60 to 65	Unsatisfactory for conference of more than two or three people; telephone use slightly difficult; normal voice 1 to 2 feet; raised voice 3 to 6 feet.
Above 65	Very noisy; office environment unsatisfactory; telephone use difficult.

Table 2.6. Noise Levels for Work Spaces, Shop Areas, etc.

Range of Levels (dB(A))	Communication Environment
70 to 80	Person-to-person communication with raised voice satisfactory 1 to 2 feet; slightly difficult 3 to 6 feet. Telephone use difficult.
80 to 90	Person-to-person communication slightly difficult with raised voice 1 to 2 feet; slightly difficult with shouting 3 to 6 feet. Telephone use very difficult.
Above 90	Person-to-person communication extremely difficult. Telephone use unsatisfactory.

Table 2.7. Noise Levels for Group Meetings, Study, Rest and Relaxation.

Range of Levels (dB(A))	Type of Space and Activities
34 to 45	Group gatherings to listen to speech and music; low background noise and good hearing conditions required; sleeping.
45 to 55	Areas where some concentration and relaxed communication may be desirable; reading rooms, sedentary relaxation; radio and television listening.
55 to 65	Good communication conditions not essential; some distraction due to external noise can be permitted; internal noise generation due to other activities may be present.

Chapter 3

HAZARDOUS NOISE SURVEILLANCE

3.1. Frequency of Surveys. Potential noise hazards shall be identified, evaluated, and controlled as an integral part of the surveys specified in AFRD 48-1, *Aerospace Medicine*, AFI 48-101, *The Aerospace Medical Program* (formerly AFR 161-33), and AFOSH Standard 161-17, *Standardized Occupational Health Program*. Specifically, the health effects of noise shall be evaluated as part of baseline workplace surveys, annual workplace surveys, and when operations change or new operations start. Additionally, surveys are performed when specific requests address the potential for hazardous noise exposure, or evaluation of other types of requests show there to be potential noise hazards. (OSHA 29 CFR 1910.95)

3.2. Noise Hazard Survey. Each Air Force workplace is unique because of the wide variety of tasks performed, facilities used, and missions performed. As a result, rigid surveillance procedures cannot be outlined. A generalized process sequence, however, coupled with the specified evaluation procedures, can be followed to ensure a uniform approach. This process has one major objective--a determination of whether or not noise exposures pose a significant risk to the hearing of workers. There are three phases to the surveillance process: recognition, evaluation, and control. The noise evaluation shall be summarized on AF Form 2758, *Industrial Hygiene Survey Data Sheet--General*, as part of the evaluation of an overall operation, or as the result of a specific problem of noise exposure. (attachment 5)

3.2.1. Recognition. The BES shall become familiar with the tasks being performed in the workplace through firsthand observation, interviews with shop personnel, review of the case file, epidemiological summaries by the Military Public Health Service (MPHS), and health record

review notes documented on the AF Form 2754, *Chronological Record of Workplace Surveillance*. Potentially hazardous noise sources should be noted during this phase to identify the need for further consideration in the evaluation phase.

3.2.2. Evaluation. The three types of noise surveys used to evaluate the noise environment are the noise source survey, the worker exposure survey, and the hazardous noise area survey. Measurements shall be made using equipment conforming to the appropriate American National Standards Institute (ANSI) standard in the references. Equipment in TA 906 meets this criterion. The forms used and the dates they were completed (such as DD Form 2214, *Noise Survey*) shall be listed in the evaluation block of the AF Form 2758 to show where the data supporting the evaluation may be found.

3.2.2.1. Noise Source Survey. This survey is used to classify a particular noise source as to whether the criterion level of 85 dB(A) is exceeded and therefore could present a potential exposure hazard to workers. Sound level meter measurements shall be made using A-weighting and C-weighting, with slow response. The results shall be documented on the DD Form 2214, explained at attachment 6. These levels shall also be recorded on the AF Form 2755 (as required by AFOSH Standard 161-17 and explained at attachment 4). If the source is potentially hazardous (above the criterion level), and engineering controls are to be considered, an octave band analysis should be accomplished. This should be documented on the AF Form 1622, *Engineering Noise Survey*, explained at attachment 7. Hazardous noise sources will be labeled where possible with an AFVA 161-3, 161-4, 161-5 or 161-6 to warn operators of the need to wear hearing protection.

3.2.2.2. Worker Exposure Measurement. Where the potential to exceed the limits of paragraph 2.1. exists,

worker exposures shall be evaluated by direct measurements with noise dosimeters, or indirectly with noise exposure calculations. (OSHA 29 CFR 1910.95) The evaluation results shall be recorded on the AF Form 2755 (explained at attachment 4). (AFOSH Standard 161-17)

3.2.2.2.1. **Calculated Noise Exposure.** The sound levels for noise sources recorded on the DD Form 2214 or AF Form 1622 may be used in conjunction with the estimated

exposure times to calculate the representative $L_{eq,T}$ for the period of interest using the formula below. Exposures below the threshold level of 80 dB(A) shall not be included in the formula. This procedure may be used to determine the need for direct dosimetry measurements or, in cases where the calculated dose is low, to rule out overexposure. This method may also be used to estimate the exposures for anticipated changes in operations or equipment. (OSHA 29 CFR 1910.95)

$$L_{eq,T} = 10 \log \left[\frac{1}{T} \sum t_i 10^{0.1 L_i} \right]$$

where:

$L_{eq,T}$ = equivalent sound level for the time period T
 L_i = sound level of each noise source above 80 dB(A);
 t_i = exposure period (minutes) for each noise source; and
 T = total time period (minutes), 480 minutes for a daily average

3.2.2.2.2. **Daily Noise Dosimeter Measurements.** Noise dosimetry may be used to measure worker noise exposure. Exposures below 80 dB(A), the threshold level, shall not be included. The time period monitored shall be at least

equal to the duration of the shift or work period less 1-hour (at least 7 hours for an 8-hour shift, 11 hours for a 12-hour shift, etc.).

For workshifts other than 8-hour periods, the measured average noise exposure should be adjusted to an 8-hour equivalent exposure level using the formula:

$$L_{eq,8Hr} = L_{eq,T} + 10 \log \frac{T}{8}$$

where,

$L_{eq,8Hr}$ = equivalent sound level for an 8-hour period
 T = length of the workshift in hours.
 $L_{eq,T}$ = measured sound level for the period T

The results of the daily monitoring shall be recorded on an AF Form 2756, 2756A or 2756B, as shown at attachment 8. The average daily equivalent continuous level (ECL or $L_{eq,T}$) over the total number of days for an individual, or group of individuals, shall be calculated according to the formula:

$$L_{eq,T} = 10 \log \left[\frac{1}{n} \sum 10^{0.1 L_{eq,Di}} \right]$$

where,

$L_{eq,T}$ = average daily equivalent continuous sound level;
 $L_{eq,Di}$ = daily equivalent continuous sound level;
 n = number of days monitored.

For noise dosimeters with displays giving the noise exposure as a percent of the daily dose, the daily equivalent sound level is first calculated from the formula:

$$L_{eq,D} = 10 \log \left[\frac{8}{T} * \frac{D}{100} \right] + 85$$

where,

$L_{eq,D}$ = equivalent daily sound level
 D = dosimeter reading (dose percent);
 T = time dosimeter was operated (hours).

3.2.2.2.3. Minimum Number of Daily Samples Required. There is no single best way to determine an adequate number of samples which represent a worker's annual average noise exposure for all work situations. Therefore, the minimum acceptable sampling criteria is as follows: A minimum of three worker-days (e.g., three workers for 1 day, one worker for 3 days) of monitoring shall be performed for representative work days. Work days immediately before or after weekends and holidays may be excluded as representative work days.

3.2.2.2.3.1. If any representative daily exposure is equal to or above 85 dB(A), personnel will be entered into audiometric monitoring.

3.2.2.2.3.2. If the 3-day average equivalent continuous exposure level (ECL) is below 82 dB(A) and all daily exposure levels are below 85 dB(A), no further monitoring is required, and personnel need not be entered into audiometric monitoring.

3.2.2.2.3.3. If the 3-day ECL is above 82 dB(A) but below the PEL, and no single day of dosimetry exceeds 85

dB(A), a minimum of ten days dosimetry will be performed. This dosimetry may include workdays bordering on weekends. Results of this dosimetry will be used to determine whether to enter personnel into audiometric monitoring.

3.2.2.2.4. Secure/Classified Areas. Noise dosimeters are authorized for use in Sensitive Compartmented Information Facilities (SCIFs), but local clearance will be obtained in advance through the facility Sensitive Compartmented Information Security Officer.

3.2.2.3. Hazardous Noise Area Evaluations. Professional judgment may be supplemented by direct measurement or calculations to determine whether an area requires posting as a hazardous noise area. For the direct measurement method, representative areas should be sampled using dosimetry to ascertain the potential for overexposure of any person entering the area. The indirect method uses the estimated or measured operating times of the sources to compute the expected exposure. The decision shall be documented on an AF Form 2758.

Chapter 4

HAZARDOUS NOISE CONTROL

NOTE: Engineering controls shall be the primary means of reducing or eliminating personnel exposure to hazardous noise. All practical design approaches to reduce noise levels below hazardous levels by engineering principles shall be explored. When engineering controls prove feasible, a RAC shall be assigned and, as appropriate, corrective action scheduled. Priorities for noise control resources will be assigned based on the applicable RAC. (AFI 91-301 [formerly AFR 127-12]) Where engineering controls are undertaken, the design objective will be to reduce steady state levels to below 85 dB(A) without regard to exposure duration and to reduce impulse noise levels to below 140 dB peak. This paragraph shall be applied to the extent possible in military unique workplaces. (DODI 6055.12, *Hearing Conservation*)

4.1. New Equipment. New equipment being considered for purchase shall have the lowest noise emission levels which are technologically and economically feasible and compatible with performance and environmental requirements. (DODI 6055.12)

4.2. New Facilities and Systems. Acoustics shall be included in developing criteria from which plans and specifications for all new facilities, modification projects for facilities, and weapon systems and subsystems are developed. The objective shall be to achieve, where feasible, a sound pressure level of less than 85 dB(A) at all locations in which personnel may be present during normal operation. (DODI 6055.12)

Chapter 5

HEARING PROTECTION

NOTE: Hearing protection shall be prescribed and used to protect personnel until engineering controls are in place, or if engineering controls are not feasible. BES will estimate at-the-ear noise exposure for each prescribed hearing protector to assure the wearer's effective exposure has been reduced to below 85 dB(A). This estimate will be documented on the AF Form 2758. Where at-the-ear noise exposures are not reduced below 85 dB(A) with single protection, noise attenuation for a suitable combination of ear plug and ear muff will be calculated. Where a combination of hearing protectors does not reduce noise levels below 85 dB(A), exposure time limits will be calculated for these at-the-ear noise exposures using Table 2.2. The types of hearing protection devices (HPDs) approved for use from the procedures below, and additional restrictions (example: time limit), will be copied from the AF Form 2758 to the AF Form 2755.

5.1. Types of Devices. Hearing protective devices include the following:

5.1.1. Insert Type Ear Plugs. An insert ear plug is a device designed to provide a seal with the ear canal. There are three types of insert ear plugs: premolded, formable, and custom ear plugs.

5.1.2. Premolded Ear Plugs. Premolded ear plugs are pliable devices of fixed proportions. Two standard styles, V-51R (single flange) and triple flange, come in various sizes, which will fit most people. Personnel responsible for fitting and dispensing ear plugs will train users on proper insertion, wear, and hygiene. While premolded ear plugs are reusable, they may deteriorate with time and will need replacement.

5.1.3. Formable Ear Plugs. Formable ear plugs come in just one size. Some are made of material which, after being compressed and inserted, expands to form a seal in the ear canal. When properly inserted, they provide noise attenuation values that are similar to those from correctly fitted premolded ear plugs. The formable ear plugs are usually considered disposable, and therefore are more expensive for long-term routine use. Individual units may procure approved formable ear plugs. Supervisors will instruct users in the proper use of these plugs prior to routine use as part of the education program. Each ear plug must be held in place while it expands enough to remain firmly seated. These ear plugs may be washed and therefore are reusable, but will have to be replaced after 2 or 3 weeks or when they no longer form an airtight seal when properly inserted.

5.1.4. Custom Molded Earplugs. A small percentage of the Air Force population cannot be fitted with standard

premolded or formable ear plugs. Custom ear plugs can be made to fit the exact size and shape of the individual's ear canal. Individuals needing custom ear plugs will be referred to an audiologist at an authorized Hearing Conservation Diagnostic Center (HCDC) or Hearing Conservation Center (HCC) (see AFOSH Standard 161-20). Air Force Bands members are the only ones authorized to obtain custom made musician's earplugs.

5.1.5. Earmuffs. Earmuffs are devices worn around the ear (circumaural) to reduce the level of noise that reaches the ear. Their effectiveness depends on a tight seal between the cushion and the head.

5.1.6. Communication Earmuffs (Electroacoustic Devices). These devices are used by personnel who must communicate in the presence of intense noise. They are fitted with earphones and, if needed, a noise shielding microphone so voice communications can be achieved during various operations. Noise exposure limits may be exceeded by the combination of external noise plus voice.

5.1.7. Combination Communications Earmuff and Ear Plug. When extremely high noise levels are present, and the attenuation given by communication earmuffs does not allow enough exposure time to complete the mission, ear plugs can be worn in addition to the earmuffs. Custom molded ear plugs can be made under the supervision of an audiologist. This combination of hearing protection should provide a longer exposure time to complete the mission. The attenuation given by the combination of communications earmuff and molded ear plug is shown in attachments 9 and 10. Information on modifications of earmuffs and fabrication of custom molded ear plugs can be obtained from the USAF Hearing Conservation Data Registry, DSN 240-2929 or 2930, or commercial (512) 536-2909 or 2930.

5.1.8. Flight Helmets. Flight helmets, whether used during ground or airborne operations, provide varying degrees of protection from noise. The ear enclosures in these devices determine the degree of protection achieved. Generally, the amount of protection provided, primarily at frequencies below 1000 Hz, varies with the condition of the ear enclosures and the acoustic seal. Headset ear enclosures and ear cushions must be maintained in good repair.

5.1.9. Noise Helmets. Noise helmets are not acceptable as a form of standard hearing protection.

5.2. Limits of Hearing Protection Performance:

5.2.1. The maximum possible sound attenuation provided by hearing protection devices (HPDs) is limited by human body and bone conduction mechanisms. Even though a

particular device may provide outstanding values of noise attenuation, the actual noise reduction may be less because the noise surrounding the head and body bypasses the hearing protector and is transmitted through tissue and bone pathways to the inner ear.

5.2.2. The term "double hearing protection" for ear plug and muff combinations is misleading. The attenuation provided from any combination ear plug and ear muff will be less than the sum of their individual attenuation values. Never add individual HPD attenuation values to derive a combination value. Always refer to test results for the specific combination of ear plug and muff in use.

5.3. Estimating Noise Attenuation for Hearing Protection Devices (HPD). The noise attenuation provided by HPDs varies between wearers, even when the wearers are highly skilled at fitting the HPDs to their ears. Noise attenuation data reported by manufacturers are given as a mean and standard deviation attenuation for a highly trained human test panel. Attenuation values for HPDs listed in this noise standard use the reported mean minus two standard deviations.

5.3.1. **Octave Band Calculations.** The preferred method to calculate HPD noise attenuation is by calculating attenuated sound levels at each octave band. (Procedure given in Attachment 8) Subtract the octave band attenuation values for the HPD from the measured levels for the noise source. The estimated at-the-ear sound levels at each octave band are then corrected to A-weighting scale, and added logarithmically for the total A-weighted sound pressure level.

5.3.2. **C Minus A Values.** Where octave band measurements have not been collected, noise attenuation may be estimated from A-weighted and C-weighted sound pressure levels of the noise source. (Procedure given in Attachment 9) Subtract the measured A-weighted level from the C-weighted level, and find the effective attenuation. Subtract the table value from the A-weighted level of the noise source to find the effective at-the-ear A-weighted noise exposure.

5.3.3. **Noise Reduction Rating (NRR).** The least preferred method of estimating HPD noise attenuation is by using the NRR. The NRR ignores frequency characteristics of the noise source by assuming equal noise

levels in each octave band. Subtract 7 dB(A) from the NRR, and subtract the adjusted NRR from the A-weighted sound pressure level for the noise source to determine at-the-ear A-weighted sound pressure level.

5.4. Fitting and Dispensing Earplugs:

5.4.1. Premolded ear plugs shall be properly fitted by MPH or qualified personnel at the HCDCs and/or HCCs, for each ear. It should be remembered about 20 percent of Air Force personnel need different size molded ear plugs for the right and left ears. An improperly sized, poorly fitted, or incorrectly worn ear plug will offer little, if any, hearing protection value.

5.4.2. Supervisors shall instruct users in the proper use and care of formable earplugs prior to routine use in the workplace as part of the training program.

5.4.3. Individuals needing custom earplugs shall be referred to an audiologist at an HCDC, HCC, or approved audiologist.

5.4.4. Instruction on the correct use and care of all hearing protective devices shall be provided as part of the annual training program.

5.4.5. Issued insert-type hearing protectors are considered personal equipment items. Individuals are encouraged to wear their ear plugs during off-duty hours, as needed.

5.5. Care and Hygiene of HPDs:

5.5.1. Reusable ear plugs, such as the V51R, triple-flange, or formable devices, should be washed in lukewarm water using hand soap, rinsed in clean water, and dried thoroughly before next use. Wet or damp ear plugs should not be placed in their containers. Cleaning should be done regularly.

5.5.2. Earmuff cushions should be kept clean. The plastic or foam cushions may be cleaned in the same way as ear plugs, but the inside of the earmuff should not get wet. When not in use, earmuffs should be placed in open air so any moisture that may have been absorbed in the cups is allowed to evaporate. Earmuff cushions should not be stored while compressed.

5.5.3. Anyone experiencing difficulty in wearing hearing protection (i.e., irritation of the ear canals) should immediately report to the medical facility.

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